

AN ROINN OIDEACHAIS

LEAVING CERTIFICATE EXAMINATION, 1976

CHEMISTRY—ORDINARY LEVEL

WEDNESDAY, 16 JUNE—AFTERNOON, 2 to 4.45

Six questions to be answered

All questions carry the same marks.

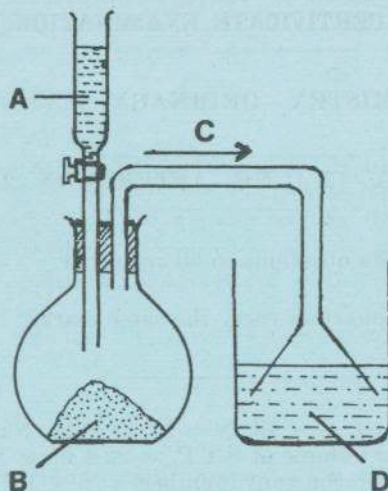
Atomic Weights: H = 1, C = 12, N = 14, O = 16, Na = 23, Ca = 40
 Molar volume at S.T.P. = 22.4 litres
 Avogadro constant (number) = 6×10^{23}

1. Answer *eleven* of the following items (a), (b), (c), etc. All the items carry the same marks. *Keep your answers short.*
- What is meant by an atomic orbital?
 - Write the names and formulae of two compounds which contain hydrogen and oxygen only.
 - How many molecules are there in 1 gram of hydrogen?
 - Write the following elements in the order in which they occur in the electrochemical series: zinc, sodium, copper.
 - Give an example of a covalent crystal.
 - Give the general formula for the alkynes. Write the structural formula for acetylene.
 - Write an equation to illustrate a substitution reaction in organic chemistry.
 - Argon is a noble (inert) gas of atomic number 18. Write down its electronic configuration (s, p).
 - What is meant by a metallic bond?
 - Give *one* typical property of the transition metals.
 - Which of the following is an amphoteric oxide?
 $\text{MgO}, \text{SO}_3, \text{Al}_2\text{O}_3, \text{NO}, \text{SiO}_2$
 - From the equation

$$\text{CaCO}_3 \xrightarrow{\text{heat}} \text{CaO} + \text{CO}_2,$$
 calculate the volume at S.T.P. of carbon dioxide obtained on heating strongly 5 grams of calcium carbonate.
 - Name an electrolyte. At which electrode does reduction occur in electrolysis?
 - Give a chemical test, with the equation of the reaction, for the sulphate ion.
 - Name either a radioactive isotope *or* an organic polymer, and state one of its uses.
2. Write the chemical equation for each of the following reactions: (i) sodium combines with chlorine to form sodium chloride, (ii) zinc reacts with dilute sulphuric acid to form zinc sulphate and hydrogen. Show how these reactions illustrate oxidation and reduction in terms of electron transfer.
 What type of bonding is present in (a) sodium chloride, (b) hydrogen? Outline, with the aid of a diagram, a simple electrical experiment in support of your answer in (a).
3. Compare electrons, protons and neutrons in terms of (i) mass, (ii) charge, (iii) location. Distinguish between atomic number and mass number.
 What is meant by ionisation energy? State the factors on which ionisation energy values depend. Comment on the general decrease in ionisation energy from top to bottom of each group in the periodic table. (Refer to Mathematics Tables p. 45).

[P.T.O.]

4. In the diagram shown a liquid *A* is dropped onto a solid *B* and a gas *C* of molecular weight 36.5 is produced. The gas (which forms dense white fumes with ammonia) dissolves very readily in water to give a solution *D*.



- (a) Identify *A*, *B*, *C*, *D*.
- (b) Which of the following pH values would you assign to the aqueous solution *D*: (i) less than 7, (ii) 7, (iii) more than 7?
- (c) Indicate the type of bonding present in *C*.
- (d) Starting with the solution *D*, show by means of equations how you would obtain a sample of (i) sodium chloride, (ii) carbon dioxide.
- (e) Write equations to illustrate what happens when (i) the gas *C* reacts with ammonia, (ii) a solution of silver nitrate is added to solution *D*.
5. Answer the following items. Refer to the periodic table of the elements (Mathematics Tables p. 44).
- (a) Name an element which forms isotopes. Give the atomic number and mass number of an isotope of the element.
- (b) Name an element which forms an ion of the type E^{2-} (where *E* is the symbol for an appropriate element).
- (c) Write the name and formula of (i) an oxide of a non-metal, (ii) a halide of an element of Group 4A, (iii) a sulphate of a metal of variable valence.
- (d) Give the name and the electronic configuration (s, p, etc.) of *two* elements from Group 1A (other than hydrogen) or Group 2A. Show how (i) their electronic configurations, (ii) their reactions with water, justify their position in the periodic table.
6. Choose any *three* of the following series of compounds: (i) alkenes, (ii) alcohols, (iii) aldehydes, (iv) carboxylic acids, and write the name and structural formula of a member of each of the series chosen. Give two reactions, typical of the series, of the member named in each case. Show, with the aid of a labelled diagram, how any *one* of the members you have named from the above series may be prepared.
7. State Hess's law. Define (i) heat of combustion, (ii) heat of formation. Calculate the heat of formation of methane from the following data:
- $$\begin{array}{l} C_{(s)} + O_{2(g)} = CO_{2(g)} \quad \Delta H = -393 \text{ kJ} \\ H_{2(g)} + \frac{1}{2}O_{2(g)} = H_2O_{(g)} \quad \Delta H = -286 \text{ kJ} \\ CH_{4(g)} + 2O_{2(g)} = CO_{2(g)} + 2H_2O_{(g)} \quad \Delta H = -879 \text{ kJ} \end{array}$$
- Name a member of the alkane series which can exist in isomeric forms.
8. What is (i) an acid, (ii) a base, in terms of the Brønsted-Lowry theory? In each of the following reactions indicate the acid, base, conjugate acid, conjugate base:
- $$\begin{array}{l} HNO_3 + H_2O \rightleftharpoons H_3O^+ + NO_3^- \\ NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^- \end{array}$$
- What is meant by pH? Calculate the pH of (i) a solution containing 0.63 gram of nitric acid in 500 cm³ of water, (ii) a 0.01 M (0.01 N) solution of sodium hydroxide.

9. A compound contains 43.4% sodium, 11.3% carbon and 45.3% oxygen by weight. Its empirical formula is the same as its molecular formula.
- Using the above data show that the compound is sodium carbonate.
 - Describe how you would make-up a 0.1 M (0.2 N) solution of sodium carbonate.
 - What volume of the 0.1 M (0.2 N) solution of sodium carbonate would be required to neutralise 20 cm³ of hydrochloric acid containing 3.65 grams per 1,000 cm³ (litre)?
 - Outline how you would carry out the titration in (c). Name a suitable indicator.
10. Give the formula for each of the following hydrides: sodium hydride, hydrogen sulphide, ammonia. In the case of each compound state (i) the physical appearance, (ii) the type of bonding involved, (iii) the reaction of the compound with water.
Outline a laboratory preparation of either hydrogen sulphide or ammonia and list its principal chemical properties.
11. Answer *two* of the following.
- What is meant by (i) an aliphatic compound, (ii) an aromatic compound?
Write the structural formula for benzene. Summarise the principal physical and chemical properties of benzene.
 - Write the name and formula of (i) a linear molecule, (ii) a planar molecule, (iii) a tetrahedral molecule and explain their shapes in terms of the electron pair repulsion theory.
 - With regard to solubility in water compare the nitrates with the carbonates.
Describe a chemical test to confirm the presence of (i) nitrate ions in aqueous solution, (ii) carbonate ions in aqueous solution.
 - What is meant by electronegativity? Comment on *two* uses of electronegativity values, giving an example in each case. (Refer to Mathematics Tables p. 46).